Egg Viability and Larval Penetration in *Trichopoda pennipes pilipes* Fabricius (Diptera: Tachinidae)[1]

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Trichopoda pennipes pilipes Fabricius was introduced into Hawaii from Trinidad in 1962 to combat the southern green stink bug, *Nezara viridula* (Fabricius) (Davis and Krauss, 1963; Davis, 1964). In Hawaii, *T. p. pilipes* has been reared from the scutellerid *Coleotichus blackburni* White and the pentatomids *Thyanta accera* (McAtee) and *Plautia stali* Scott, in addition to *N. viridula.*

During 1965 we began a study on the biology of *T. p. pilipes* in relation to its principal host in Hawaii, *N. viridula.* Laboratory experiments and observations were conducted to evaluate the effects of superparasitization of *N. viridula* by the tachinid on both the host and parasite populations. The results of some of this work were reported previously (Shahjahan, 1968). The present paper summarizes data which were obtained on parasite egg viability and larval penetration of host integument. The methods used in rearing and handling both *N. viridula* and *T. p. pilipes* were described in the earlier paper (Shahjahan, 1968).

SUPERNUMERARY OVIPOSITION AND EGG VIABILITY

Adults of the southern green stink bug often are heavily superparasitized by *T. p. pilipes,* both in the field and under laboratory conditions. As many as 237 *T. p. pilipes* eggs were counted on a single field-collected stink bug, and a high of 275 eggs were deposited on one bug in the laboratory (Shahjahan, 1968). Eggs are placed predominantly on the venter of the thorax, but may be deposited on almost any part of the host, including the appendages, wings, eyes, etc. Hatching larvae penetrate the host directly from within the egg shell, and those deposited at unsuitable sites, such as the appendages and wings, are unable to penetrate the body cavity. Although several larvae often enter the body, only one is able to complete development (Shahjahan, 1968).

In assessing superparasitization by the tachinid, both egg fertility (as evidenced by embryo development) and egg viability (evidenced by hatching and successful penetration of the host) were considered. Following exposure to female *T. p. pilipes,* parasitized stink bugs were maintained on a diet of fresh string beans for 7 days; almost twice the normal incubation time for eggs of this parasite. The number of eggs on each host was then recorded, and the eggs were detached for determination of fertility and hatchability. Empty hatched eggs were easily recognized by the presence of a small, circular emergence hole located below the mi-

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cropylar region. Total successful larval penetration was determined by bisecting and immersing the host in 10% KOH for 48 hours, and then counting the contained larval mouth-hooks. Total egg fertility was calculated by adding the number of unhatched eggs containing developed embryos to the number of hatched eggs. Eggs in which embryos did not develop were considered to be infertile. The data from 10 trials are summarized in Table 1. The number of eggs laid on a single host ranged from 2 to 53 and averaged 18.9 in these tests. Of the eggs laid, slightly more than one-half yielded larvae which were able to successfully penetrate the host integument.

TABLE 1.—*Egg fertility and larval penetration of* Trichopoda pennipes pilipes *on superparasitized southern green stink bugs.*

Test no.	*No. hosts*	*Average no. parasite eggs per host*	*Percent egg fertility*	*Percent successful larval penetration*
1	30	22.0	90.6	49.0
2	32	15.0	98.3	49.3
3	35	5.2	93.3	63.6
4	38	11.0	88.6	57.3
5	30	8.3	72.3	42.3
6	28	37.6	85.3	48.6
7	25	27.3	88.6	62.6
8	27	21.6	95.3	75.0
9	36	13.0	54.6	23.0
10	32	28.3	81.0	49.0
TOTALS	313	18.9	87.7	51.9

Effect of Host Age on Parasite Penetration

Casual observations suggested that the integument of *N. viridula* might become harder as the insect ages. For this reason, it was thought that successful penetration by *T. p. pilipes* larvae might be greater in young hosts than in older ones. To test this hypothesis, groups of stink bugs of various ages, ranging from 6 to 48 days, were exposed to females of *T. p. pilipes* for 2-3 days. The number of eggs deposited on each host was recorded, and parasitized hosts were held until parasite emergence, or death. Host remains were then dissected in KOH and parasite mouthhooks were counted to determine the number of successful larval penetrations. Results of these tests are summarized in Table 2. Regression coefficients derived from these data were not significant, indicating that host adult age had no detectable influence on penetration by *T. p. pilipes* larvae.

TABLE 2.—*Effect of host age on the penetration and survival of* Trichopoda pennipes pilipes *larvae.*

Adult age of hosts (days)	*No. of hosts studied*	*Percent successful larval penetration*	*Percent of hosts producing parasites*
6	22	60	82
8	15	62	81
10	16	45	75
12	20	55	70
18	22	44	76
24	15	56	67
30	22	38	73
38	22	52	81
40	18	48	67
48	24	36	75

Discussion and Conclusions

Multiple oviposition by *Trichopoda pennipes pilipes* on *Nezara viridula* individuals occurs commonly in both field and laboratory. The large numbers of eggs which sometimes are deposited on individual hosts suggests that the presence of previously laid eggs has little or no deterrent effect on parasite oviposition. Despite the high degree of supernumerary oviposition exhibited by *T. p. pilipes* field parasitization of *N. viridula* by this species, based upon emergence of mature parasite larvae, ranged between 24 and 86 per cent on string beans in Hawaii (Shahjahan and Beardsley, unpublished). The actual value probably was somewhat higher due to premature death of a portion of the superparasitized hosts without parasite emergence (Shahjahan, 1968).

The fecundity of *T. p. pilipes* females is relatively high; laboratory reared flies laid an average of 235 eggs per female when fed on raisins (Shahjahan, 1968). The deposition of several eggs per host may have some positive survival value for this parasite inasmuch as the survival rate of newly hatched larvae is relatively low. This is due both to the placement of some eggs at unsuitable sites (such as wings and appendages) and to the failure of a portion of the larvae from eggs laid at suitable sites to penetrate the host integument. In the laboratory, only about one-half of the eggs laid produced larvae which successfully penetrated the host. The deposition of around 4 to 8 parasite eggs per host resulted in the production of adult parasites from 65 to 78 per cent of the parasitized hosts. A high degree of superparasitism (up to 14 parasite larvae per host) reduced the production of adult parasites to around 38% of parasitized hosts (Shahjahan, 1968a).

Worthley (1924) stated that larvae of *Trichopoda pennipes* Fabricius were able to penetrate the integument of the squash bug, *Anasa tristis* De Geer, regardless of its thickness. Beard (1940) reported, however, that many larvae of this parasite failed to penetrate the body wall of

older more heavily sclerotized squash bugs. In Hawaii, we found no correlation between the adult age of *Nezara viridula* and penetration by larvae of *T. p. pennipes,* and therefore concluded that the relatively low percentage of successful penetration by larvae of this parasite was not due to an increase in integumental hardness with age.

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